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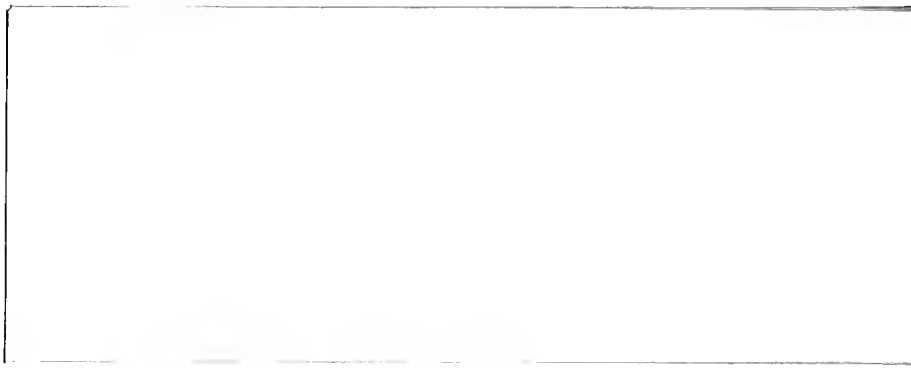of economics
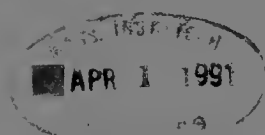
COST PADDING, AUDITING AND COLLUSION

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Abstract

This paper first studies how cost padding, auditing and collusion with auditors affect the power of incentive schemes in procurement and regulation. Unaudited cost padding requires fixed price contracts. Incentive schemes are more powerful under imperfect auditing than under perfect auditing and less powerful than under no auditing. The effect of collusion in auditing on the optimal power of incentive schemes is ambiguous; high-powered schemes reduce the incentive for cost padding and thus are less affected by collusion; however, they also yield higher rents and therefore make firms more willing to prevent release of evidence of cost padding.

Monitoring of effort, the second topic of this paper, is a substitute for the use of low-powered incentive schemes to extract the informational rents. It thus enables the regulator to afford more powerful incentive schemes. Collusion in auditing unambiguously lowers the power of incentive schemes.

1. Introduction.

Accounting manipulations are a serious concern in procurement[1] and regulation,[2] as well as in large organizations, because they reduce the information value of cost data and thus the effectiveness of management control systems. The purpose of this paper is, first, to study the effect of accounting contrivances and auditing on the power of incentive schemes,[3] and, second, to analyze the scope for collusion between the auditor and the auditee.

The standard model in which cost depends on technology and effort[4] is a polar case where accounting manipulations that transfer money to the firm or its managers -- cost padding -- are perfectly and costlessly monitored. In practice, there are many ways for a firm to divert money: subsidization of R&D with commercial purposes or advertising for corporate image charged to the project, transfer of funds among divisions with different cost reimbursement rules, compensation for personal services, salaries and stock options of managers, charge for depreciated assets, royalties, bad debts or losses on other contracts. Substantial resources are committed to audit non allowable expenses. And there is concern not only that regulated firms unduly charge the government, but also that their auditors are too lenient. For years, the

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[1]See, e.g., Rogerson [1990], and Trueger [1966].

[2]See, e.g., Berg-Tschirhart [1988] and Kahn [1971].

[3]There is a vast literature (see, for example, Antle [1982], [1984], Fellingham and Newman [1985], Kumar [1989], Wilson [1983]) on the analysis of auditing in a principal-agent framework. Little however has been written on the interaction between the power of incentive schemes used in regulation or procurement and auditing.

[4]Auditing models have typically assumed that the object of the audit is the value of the technological parameter. See, for instance, Baron-Besanko [1984] for a model in which total cost is unobservable, and Laffont-Tirole [1986], [1988] and Kofman-Lawarrée [1989] for models in which it is observable.

U.S. General Accounting Office has reported to the Congress on alleged overpricing of defense contracts and argued that the Department of Defense ought to conduct stricter audits and be harsher if the contractor submits defective data.[5] Similarly, the regulatory agencies' actions to check cost padding are under surveillance.

The effect of cost padding on incentives can be apprehended by first recalling the basic conflict between incentives and the extraction of the firm's informational rent, and, second, by noting that the existence of cost padding is closely connected to the regulator's desire to extract the rent. Incentives for cost reduction (effort) are best provided by high-powered schemes, in particular by the fixed-price contract in which the firm is residual claimant for its cost savings. High-powered schemes, however, allow large rents, which may be reduced by cost sharing between the government and the firm (see Section 2). Cost padding would never arise if rent extraction were not a regulatory concern. For, the regulator would offer a fixed-price contract and the firm would have no incentive to engage in cost padding because it would pay the integrity of each dollar diverted. The rent extraction motive, by leading to cost sharing, breeds cost padding.

The key observation is that <u>at a given cost</u> (claimed, but not necessarily allowed), efficient types engage in more cost padding than inefficient ones. This results from the fact that, to reach the same cost, cost padding must be offset by more effort, which is cheaper to provide for the efficient types. [But beware: this property holds only for a given cost level. In equilibrium, different types produce at different costs, and, as we shall see, more efficient types choose more powerful incentive schemes and engage in <u>less</u>

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[5] The potential for capture creates scope for auditing by multiple, "internal" and "external," auditors as in Kofman-Lawarrée [1989].

cost padding.] Hence, a deterioration in the audit of cost padding makes it more difficult to extract rent and privileges incentives over rent extraction. As intuition would suggest, incentive schemes move toward fixed-price contracts when cost padding becomes harder to detect.

The incentive effect of collusion between the auditor and the firm is more subtle. On the one hand, collusion impairs audits, which, as we have seen, raises the desirability of high powered schemes. On the other hand, high powered schemes induce more cost reducing effort, which must be compensated by high transfers to the firm. These high transfers raise the stakes in collusion, because the firm loses more when the auditor reveals cost padding. Thus, the threat of collusion calls for low-powered schemes to reduce the stakes. Either of these two effects may dominate, so that collusion may increase or decrease the power of incentive schemes.

An interesting by-product of the analysis is that maximal penalties may not be optimal even though the firm is risk neutral. High penalties create scope for collusion, and it may be cheaper to reduce penalties than pay the auditor large amounts for truthful reporting. [We show that it may be strictly optimal to choose a penalty intermediate between no penalty and the maximal penalty. Kofman-Lawarrée [1989] exhibit a situation in which the principal is indifferent between the maximal penalty or a lower penalty when the auditor and the agent can collude. As they show, this weak optimality of non-maximal penalties can be made strict by assuming that the auditor pays a fee for the right to audit.]

Our model has two moral hazard variables, and studies the effect of auditing one -- cost padding -- on the other -- cost reducing effort. While cost padding represents the accounting transfers discussed above, the cost-reducing activity stands for the decisions that determine the real (as opposed to measured) cost: length and intensity of work, avoidance of

leisurely meetings, lunches or discussions with colleagues, willingness to learn new techniques or tackle new and challenging ideas, etc. [It is important to note that this distinction between real costs and transfers is for convenience only. In practice, there is a continuum of moral hazard variables that, together with the exogenous technological conditions, determine cost. For instance, first class travel by employees, nice offices and entertainment expenditures fall in between these two stereotypes. And where they fall depends on, first, the deadweight loss associated with the activity (would employees have flown first class anyway?) and, second, on the ease with which they are audited. Pure cost padding involves no deadweight loss (is a simple accounting trick), while shirking is inefficient; also auditors are more likely to find verifiable evidence of cost padding than of shirking.]

After developing the analysis of cost padding in Section 3, we study in Section 4 the effect of monitoring the effort. While the monitoring of effort is in practice substantially more difficult than the audit of cost padding (at least in the regulatory context), its analysis serves as a useful reference. It is shown that, in contrast with the audit of cost padding, the monitoring of effort raises the power of incentive schemes.

2. Benchmark (no cost padding, no auditing).

A project valued S by the consumers can be realized by a firm with the following technology:

(2.1) $C = \beta - e_1$.

Cost is determined by an efficiency parameter $\beta \in \{\underline{\beta}, \bar{\beta}\}$, $\bar{\beta} > \underline{\beta}$, known only to the firm and by an effort level e_1 which brings a disutility to the firm of $\psi(e_1)$, in monetary terms ($\psi' > 0$, $\psi'' > 0$, $\psi''' \geq 0$).[6] The regulator

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[6] $\psi''' \geq 0$ ensures that stochastic schemes are not optimal.

has prior probability ν that $\beta = \underline{\beta}$. [Because we ignore collusion in a first step, we make no distinction between the regulator and his superior.] We let $\Delta\beta = \bar{\beta} - \underline{\beta}$.

We take the accounting convention that the regulator reimburses the cost and pays in addition a net transfer t. The firm's utility level is accordingly:

(2.2) $U = t - \psi(e_1)$.

If $1+\lambda$, $\lambda > 0$, is the opportunity cost of public funds, the consumers' net utility is:

(2.3) $S - (1+\lambda)(t+\beta-e_1)$.

For a utilitarian regulator, social welfare is

(2.4) $S - (1+\lambda)(t+\beta-e_1)+t-\psi(e_1) = S-(1+\lambda)(\beta-e_1+\psi(e_1))-\lambda U$.

Under complete information about β and e_1, the regulator maximizes social welfare under the individual rationality (IR) constraint of the firm:

(2.5) $U = t - \psi(e_1) \geq 0$.[7]

Optimal regulation under symmetric information entails $e_1 = e^*$ with $\psi'(e^*) = 1$, i.e., effort is optimal (marginal cost of effort equals marginal benefit of effort) and $t = \psi(e^*)$, i.e., no rent is left to the firm.[8] We make the maintained assumption that S is sufficiently large that the regulator never wants to shut down the firm.

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[7] We normalize the opportunity level of utility at zero.

[8] If the firm has complete information about β only, this optimal regulation is also achieved by requiring cost level $\underline{\beta}-e^*$ from the efficient type and cost level $\bar{\beta}-e^*$ from the inefficient type.

Assume now that the regulator does not know β and does not observe e_1. Let $(\underline{t}, \underline{C})$, $(\bar{t}, \bar{C})$ denote a pair of contracts for types $\underline{\beta}$ and $\bar{\beta}$. Incentive compatibility requires that the efficient type not gain by behaving like an inefficient one:

(2.6) $\underline{U} = \underline{t} - \psi(\underline{\beta} - \underline{C}) \geq \bar{t} - \psi(\underline{\beta} - \bar{C})$.

[We ignore the incentive compatibility constraint for the inefficient type. As is usual, it can be checked ex post that this constraint is not binding.] The individual rationality constraint for the inefficient type is

(2.7) $\bar{t} - \psi(\bar{\beta} - \bar{C}) \geq 0$.

At the regulator's optimum, (2.6) and (2.7) are binding, and the efficient type's rent is $\underline{U} = \Phi(\bar{e}_1) = \Phi(\bar{\beta} - \bar{C})$,

where

(2.8) $\Phi(e_1) \equiv \psi(e_1) - \psi(e_1 - \Delta\beta)$.

The regulator maximizes expected social welfare:

(2.9) $W = S - \nu[(1+\lambda)(\underline{\beta} - \underline{e}_1 + \psi(\underline{e}_1)) + \lambda\Phi(\bar{e}_1)] - (1-\nu)(1+\lambda)(\bar{\beta} - \bar{e}_1 + \psi(\bar{e}_1))$,

with respect to $\underline{e}_1$ and $\bar{e}_1$, yielding

(2.10) $\psi'(\underline{e}_1) = 1 \iff \underline{e}_1 = e^*$

and

(2.11) $\psi'(\bar{e}_1) = 1 - \dfrac{\lambda}{1+\lambda}\dfrac{\nu}{1-\nu}\Phi'(\bar{e}_1) \implies \bar{e}_1 \equiv \bar{e}_0 < e^*$.

The efficient type's effort is not distorted by asymmetric information. The effort of the inefficient type is reduced relative to the full information optimum in order to limit the efficient type's rent: Rent extraction concerns lead to "low-powered" incentives.

In the whole paper, it will be optimal for the principal not to distort the efficient type's effort. The power of the optimal incentive scheme will thus be measured by the effort level of the inefficient type.

3. Audit of Cost Padding.

3.1 Benevolent audit of cost padding.

We now let the managers engage in two activities:[9] cost reduction $(e_1 \geq 0)$ and cost padding $(e_2 \geq 0)$. The cost function is

(3.1) $C = \beta - e_1 + e_2$.

We ignore monitoring of effort (see Section 4) and focus on the audit of cost padding. We formalize the audit technology in the following way: Given a level of cost padding e_2, the auditor receives a signal (or measured cost padding) e_2^m with conditional distribution $G(e_2^m | e_2)$ on $[0, +\infty)$. We let $T(C, e_2^m, e_2)$ denote the firm's net income when producing at cost C and choosing cost padding e_2 and when the outcome of the audit is e_2^m. The function $T(\cdot, \cdot, \cdot)$ depends on (i) the incentive scheme set up by the principal, (ii) the level of limited liability of the firm, in particular, whether part of or the integrity of the cost padding can be recouped by the principal when it is discovered, and (iii) the deadweight loss involved in engaging in cost padding. We will later assume for concreteness that the firm may consume the level of cost padding before the audit, so that the regulator cannot recoup any fraction. Then $T(C, e_2^m, e_2) = t(C, e_2^m) + h(e_2)$, where $t(\cdot, \cdot)$ is the net transfer following the audit and satisfies $t(\cdot, \cdot) \geq 0$ (from limited liability), and $0 \leq h(e_2) \leq e_2$ (so $e_2 - h(e_2)$ is the deadweight loss associated with the diversion of funds). But, at this stage, we want to keep the

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[9]Lewis [1990] also develops a model of cost inflation in which the regulated firm engages in two activities. In our notation the firm's utility is $U = t(C) + e_2 - \varsigma e_2^2 - \gamma(\beta - C + e_2)^2$. That is, any cost inflation is consumed by the firm (with some deadweight loss). There is no (explicit) audit. Lewis shows that $e_2 > 0$ except for the most efficient type; that e_2 is positively correlated with actual costs $(\beta - C + e_2)$; that the regulator can use a menu of linear contracts; and that incentive schemes become less powerful with increases in ς.

formulation as general as possible.

For a given cost C, the firm chooses a level of cost padding so as to solve

$$(3.2) \qquad \underset{e_2}{\text{Max}} \int [T(C,e_2^m,e_2) - \psi(\beta-C+e_2)] dG(e_2^m|e_2).$$

Cost padding requires the managers to exert more effort to reach a given cost. This suggests that, for a given cost, a more efficient firm will engage in more cost padding, as the marginal disutility of reducing cost is lower:

Proposition 1: Fix a cost C, and consider two types $\beta < \bar{\beta}$. If e_2 and $\tilde{e}_2$ are optimal levels of cost padding for β and $\bar{\beta}$, respectively,

$$e_2 \geq \tilde{e}_2.$$

Proof: The proof uses a simple revealed preference argument. Let $\bar{T}(C,e_2) \equiv \int T(C,e_2^m,e_2) dG(e_2^m|e_2)$. Revealed preference implies that

$$(3.3) \qquad \bar{T}(C,e_2) - \psi(\beta-C+e_2) \geq \bar{T}(C,\tilde{e}_2) - \psi(\beta-C+\tilde{e}_2)$$

and

$$(3.4) \qquad \bar{T}(C,\tilde{e}_2) - \psi(\bar{\beta}-C+\tilde{e}_2) \geq \bar{T}(C,e_2) - \psi(\bar{\beta}-C+e_2).$$

Adding up (3.3) and (3.4) and using the convexity of $\psi(\cdot)$ shows that $e_2 \geq \tilde{e}_2$.

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Remark: The proposition asserts that efficient types do more cost padding for a given cost level. It does not imply that efficient types do more cost padding in equilibrium, because in general they produce at different cost levels. Indeed, we will see that, in the two-type case ($\underline{\beta} < \bar{\beta}$), the efficient type exerts the socially efficient level of cost reducing effort (that which would result from a fixed price contract) and the inefficient type exerts a

suboptimal effort. Because the efficient type's marginal disutility of effort is equal to one, one dollar diverted through cost padding requires an extra effort with monetary disutility equal to one; the efficient type thus does not engage in cost padding. In contrast, the inefficient type's marginal disutility of effort is lower than one, which may give it an incentive to engage in cost padding.

Let us now consider the two polar cases of perfect and no audit of cost padding. We will later analyze the richer case of imperfect audit.

Perfect audit: If cost padding is perfectly observable while cost reducing effort is non observable, the principal can require $e_2 = 0$ and thus obtain the level of welfare determined in Section 2. In particular, type $\bar{\beta}$'s effort is equal to $\bar{e}_0$.

No audit: In contrast, suppose that $e_2^m = 0$ for any e_2 (the signal is uninformative) and that the firm's utility is equal to $\{t(C)+e_2-\psi(\beta-C+e_2)\}$, where $t(C)$ is the transfer for realized cost C. Note that this formulation of "no audit" embodies the assumption that there is no deadweight loss associated with cost padding; that is, the firm derives utility \$1 from padding cost by \$1.

Because the firm chooses e_2 so as to maximize its utility, it seems intuitive that only effort $e_1 = e^*$ (the effort corresponding to a fixed price contract) can be implemented. Things are slightly more complicated than intuition suggests because of the non-negativity constraint $e_2 \geq 0$. The maximization of the firm's utility with respect to e_2 only implies that for any β and C chosen by type β,

(3.5) $1 \leq \psi'(\beta-C+e_2)$, and $e_2 = 0$ if $\psi'(\beta-C+e_2) > 1$.

Now, let $(\bar{C}, \bar{e}_2)$ denote type $\bar{\beta}$'s equilibrium choices. Note that type $\underline{\beta}$ can mimic cost level $\bar{C}$. We claim that when doing so, it obtains at least rent $\Delta\beta$:

(3.6) $\underline{U} \geq \Delta\beta$.

To see this, assume first that $\underline{\beta}-\bar{C}+\bar{e}_2 \geq e^*$. Then $\bar{\beta}-\bar{C}+\bar{e}_2 > e^*$, so that $\bar{e}_2 = 0$ from (3.5). Furthermore, type $\underline{\beta}$ can mimic both cost level $\bar{C}$ and cost padding 0 and obtain

$$\Phi(\bar{\beta}-\bar{C}) = \psi(\bar{\beta}-\bar{C}) - \psi(\underline{\beta}-\bar{C}) \geq \Delta\beta,$$

as $\underline{\beta}-\bar{C} > e^*$, $\psi'(e^*) = 1$, and $\psi(\cdot)$ is convex. Second, suppose that $\underline{\beta}-\bar{C}+\bar{e}_2 < e^*$ (while $\bar{\beta}-\bar{C}+\bar{e}_2 \geq e^*$ from (3.5)). Then, when mimicking $\bar{C}$, type $\underline{\beta}$ engages in cost padding $e_2 > \bar{e}_2$, where $\underline{\beta}-\bar{C}+e_2 = e^*$. Its utility is then equal to

$$[e_2-\bar{e}_2]+[\psi(\bar{\beta}-\bar{C}+\bar{e}_2)-\psi(e^*)] \geq [e^*+\bar{C}-\underline{\beta}-\bar{e}_2] + [\bar{\beta}-\bar{C}+\bar{e}_2-e^*] = \Delta\beta.$$

Now, (3.6) implies that the principal's welfare is bounded above by

(3.7) $W = \max_{\{\underline{e}_1, \bar{e}_1\}} \{\nu[S-(1+\lambda)(\underline{\beta}-\underline{e}_1+\psi(\underline{e}_1))-\lambda\Delta\beta]+(1-\nu)[S-(1+\lambda)(\bar{\beta}-\bar{e}_1+\psi(\bar{e}_1))]\}$

Note that this maximum is reached for $\underline{e}_1 = \bar{e}_1 = e^*$. Conversely, this upper bound can be obtained by offering the fixed price contract $t(C) = \psi(e^*)-[C-(\bar{\beta}-e^*)]$. Because the firm is residual claimant for its cost savings, it chooses $e_1 = e^*$ and $e_2 = 0$ for any type. We thus have:

Proposition 2: (a) Under perfect audit of cost padding, the outcome is the same as in the absence of cost padding, i.e., is the one determined in Section 2. Type $\bar{\beta}$'s effort is $\bar{e}_0$.

(b) In the absence of audit of cost padding, the principal foregoes rent extraction and offers a single fixed-price contract. In particular, type $\bar{\beta}$'s effort is equal to $e^* > \bar{e}_0$.

This Proposition gives a simple illustration of the idea that unfettered cost padding leads to an increase in the power of incentive schemes.

Imperfect Cost Padding

We now study a simple model with two levels of cost padding: $e_2 = 0$ and $e_2 = \alpha > 0$. The audit yields one of two signals: $e_2^m = 0$ and $e_2^m = \alpha$. We let $x = \mathrm{Prob}(e_2^m = 0 \mid e_2 = 0)$ and $y = \mathrm{Prob}(e_2^m = 0 \mid e_2 = \alpha)$, and assume $1 > x > y > 0$. That is, we allow for the possibility of mistakes, and we assume that the auditing technology satisfies the monotone likelihood ratio property that actual cost padding makes a cost padding signal more likely.

For a given cost $C = \beta - e_1 + e_2$, the principal gives transfers to the firm, t_0 when $e_2^m = 0$ and t_α when $e_2^m = \alpha$. The firm's expected utility is then

$$
U = \begin{cases}
x t_0 + (1-x) t_\alpha - \psi(\beta - C) & \text{if } e_2 = 0 \\
\\
y t_0 + (1-y) t_\alpha + \alpha' - \psi(\beta - C + \alpha) & \text{if } e_2 = \alpha.
\end{cases}
$$

We impose the limited liability constraints t_0, $t_\alpha \geq 0$, and assume that $0 \leq \alpha' \leq \alpha$. Several comments are in order. First, we allow cost padding to create a deadweight loss ($\alpha' < \alpha$). For instance, transfers of money from one account under contract into an unregulated account involve no deadweight loss ($\alpha' = \alpha$) if they are routine accounting manipulations, but do impose such a loss if they require a substantial amount of accounting expertise and time. Similarly, cost padding through increases in managerial compensation creates a deadweight loss if the need to hide these increases creates an inefficient structure of managerial compensation. Second, we assume that α' is consumed by the firm before the audit and cannot be recouped by the principal. It is straightforward to extend the model to allow partial or full recovery of the money set aside.

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Assuming auditing is costless, the regulator's objective function is

(3.8) $W = S - (1+\lambda)(C+Et) + U$

$$= \begin{cases} S - (1+\lambda)(\beta - e_1 + \psi(e_1)) - \lambda U & \text{if } e_2 = 0 \\ S - (1+\lambda)(\beta - e_1 + \alpha - \alpha' + \psi(e_1)) - \lambda U & \text{if } e_2 = \alpha. \end{cases}$$

In a first step, we assume that the auditor does not collude with the firm, and consider several regimes. (Appendix 1 contains more detailed arguments).

In the <u>cost-padding regime</u>, type $\bar{\beta}$ engages in cost padding ($e_2 = \alpha$); and so would type $\underline{\beta}$ if he were to mimic type $\bar{\beta}$ (from Proposition 1). The regulatory outcome is then the same as in the absence of cost padding (see Section 2), except for the deadweight loss $(1-\nu)(1+\lambda)(\alpha-\alpha')$.[10] This regime is optimal if either cost padding is hard to detect (y close to x) or harmless (α' close to α). We now study more interesting regimes, in which type $\bar{\beta}$ does not engage in cost padding.

Let $\bar{C} = \bar{\beta} - \bar{e}_1$ denote the cost realized by type $\bar{\beta}$ and $(\bar{t}_0, \bar{t}_\alpha)$ the associated transfers. One has

(3.9) $\bar{U} = x\bar{t}_0 + (1-x)\bar{t}_\alpha - \psi(\bar{e}_1) = 0.$

Type $\underline{\beta}$'s rent is determined by his possibility of mimicking type $\bar{\beta}$. When choosing cost $\bar{C}$, it can choose either $e_2 = 0$ or $e_2 = \alpha$. Therefore, using (3.9), we obtain two lower bounds for his rent according to the way he mimicks the inefficient type:

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[10] The intuition for this result is as follows: the inefficient type's allocation of effort is distorted to limit the efficient type's rent of asymmetric information $\underline{U}$. This rent, which equals the efficient type's utility level when he mimics the inefficient type, is as in Section 2:

$$\underline{U} = y\bar{t}_0 + (1-y)\bar{t}_\alpha + \alpha' - \psi(\bar{\beta} - \bar{C} + \alpha) = \psi(\bar{\beta} - \bar{C} + \alpha) - \psi(\underline{\beta} - \bar{C} + \alpha) = \psi(\bar{e}_1) - \psi(\bar{e}_1 - \Delta\beta) = \Phi(\bar{e}_1).$$

(3.10) $\underline{U} \geq \Phi(\bar{e}_1)$

and

(3.11) $\underline{U} \geq y\bar{t}_0 + (1-y)\bar{t}_\alpha + \alpha' - \psi(\bar{e}_1 \cdot \Delta\beta + \alpha) - \Gamma(\bar{e}_1, \bar{t}_\alpha)$,

where

(3.12) $\Gamma(\bar{e}_1, \bar{t}_\alpha) = \left[\frac{y}{x}\psi(\bar{e}_1) - \psi(\bar{e}_1 \cdot \Delta\beta + \alpha)\right] + \left[(1-y) - y\frac{(1-x)}{x}\right]\bar{t}_\alpha + \alpha'$.

We can now define the <u>classical</u> <u>regime</u>, in which (3.11) is not binding. In this case, the optimal regulatory outcome is the same as when cost padding is infeasible, and is determined in Section 2.[11] A necessary and sufficient condition for the classical regime to obtain is that type β does not want to deviate to cost $\bar{C}$ and cost padding α. That is, using (3.9),

(3.13) $\Phi(\bar{e}_0) \geq \left[\frac{y}{x}\psi(\bar{e}_0) - \psi(\bar{e}_0 \cdot \Delta\beta + \alpha)\right] + \alpha'$

(because $x < y$, $\Gamma(\bar{e}_0, \cdot)$ is minimized at $\bar{t}_\alpha = 0$). Recalling that $\Phi(\bar{e}_0) = \psi(\bar{e}_0) - \psi(\bar{e}_0 \cdot \Delta\beta)$, and that ψ is convex, we conclude that the classical regime obtains if cost padding can be detected well (y/x small) or if it entails a substantial deadweight loss (α' much smaller than α).

The third regime, the <u>repressed</u> <u>cost-padding</u> <u>regime</u>, defined by the conditions that type $\bar{\beta}$ does not engage in cost padding, but (3.11) is binding, is the only non-trivial regime. Let κ and ς denote the Lagrange multipliers of constraints (3.10) and (3.11), where $\varsigma > 0$ by assumption. The principal maximizes

(3.14) $W = \nu[S - (1+\lambda)(\beta - e^* + \psi(e^*)) - \lambda\underline{U}]$

$+ (1-\nu)[S - (1+\lambda)(\bar{\beta} - \bar{e}_1 + \psi(\bar{e}_1))]$

$+ \kappa[\underline{U} - \Phi(\bar{e}_1)] + \varsigma[\underline{U} - \Gamma(\bar{e}_1, \bar{t}_\alpha)]$.

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[11]The reasoning is the same as in the previous footnote, except that $\bar{e}_2 = 0$ instead of $\bar{e}_2 = \alpha$.

As before, the monotone likelihood ratio property implies that punishments are maximal: $\bar{t}_\alpha = 0$. The derivatives of W with respect to $\underline{U}$ and $\bar{e}_1$ are:

(3.15) $-\lambda\nu+\kappa+\zeta = 0$

(3.16) $(1-\nu)(1+\lambda)(1-\psi'(\bar{e}_1))-\kappa\Phi'(\bar{e}_1)-\zeta\frac{\partial\Gamma}{\partial\bar{e}_1}(\bar{e}_1,0) = 0,$

and therefore

(3.17) $\psi'(\bar{e}_1) = 1 - \frac{\lambda\nu}{(1+\lambda)(1-\nu)}\Phi'(\bar{e}_1) + \frac{\zeta}{(1+\lambda)(1-\nu)}\left[\Phi'(\bar{e}_1)-\frac{\partial\Gamma}{\partial\bar{e}_1}(\bar{e}_1,0)\right].$

Equation (3.17) and the fact that $\Phi'(e_1) > \frac{\partial\Gamma}{\partial e_1}(e_1,0)$ for all $e_1 \geq 0$, yield our main conclusion: Incentives are more powerful under imperfect auditing than under perfect auditing. A corollary is that the efficient type's rent is higher under imperfect auditing than under perfect auditing.

The intuition for this result is that increasing $\bar{e}_1$ is more attractive under cost padding for two reasons. First, increasing $\bar{e}_1$ raises the transfer $\psi(\bar{e}_1)/x$ to the inefficient type when no cost padding is discovered. Because, from Proposition 1, the efficient type tends to do more cost padding, cost padding (which raises the probability of not receiving the transfer) becomes more costly to the efficient type, which reduces his rent. Second, cost padding raises the marginal disutility $\psi'(\bar{e}_1-\Delta\beta+e_2)$ of the efficient type to mimic the inefficient type. Again, an increase in $\bar{e}_1$ increases the efficient type's rent by less than in the absence of cost padding.

Proposition 3: In the absence of collusion, punishments are maximal ($\bar{t}_\alpha = 0$). The inefficient type's effort exceeds that under perfect auditing of cost padding: $\bar{e}_1 \geq \bar{e}_0$ (and the efficient type's effort is still the socially optimal one).

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3.2 Collusion in auditing.

Let us now allow collusion between the firm and the auditor. We assume that the auditor's utility function is $V(s) - s$, where $s \geq 0$ is his income. [The benevolent auditor case of Section (3.1) thus corresponds to a flat wage $s = 0$ inducing truthful revelation of the outcome of the audit.] The auditor may be captured by the firm. Let $(1+\lambda_f)$ be the marginal cost of internal side payments in the auditor firm coalition ($\lambda_f \geq 0$ can be thought of as an organization or distribution cost -- see Laffont-Tirole [1988]). Suppose that when $e_2^m = \alpha$, the auditor can pretend he has observed no cost padding. That is, his report satisfies $r(\alpha) \in \{0,\alpha\}$ (while $r(0) = 0$). To prevent collusion, the principal must give income s_α to the auditor when $r = \alpha$ that satisfies

$$(3.18) \qquad s_\alpha \geq \frac{\bar{t}_0 - \bar{t}_\alpha}{1+\lambda_f},$$

where λ_f is the organization cost.

Welfare in the cost-padding regime is not affected by the possibility of collusion, because the principal, who allows cost padding by type $\bar{\beta}$, may as well choose $\bar{t}_0 = \bar{t}_\alpha$ ($= \psi(\bar{e}_1) - \alpha'$). Therefore, $s_\alpha = 0$ does not give rise to collusive behavior.

In the classical and repressed cost-padding regimes, no type engages in cost padding, but s_α must be paid with the probability $(1-x)$ of mistake. Hence, $\lambda(1-x)s_\alpha$ must be subtracted from the social welfare function.[12] Furthermore, s_α is never equal to 0, because this would require $\bar{t}_0 = \bar{t}_\alpha$, which would make cost padding a strictly optimal strategy for all types.

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[12]This results from our assumption that the regulator cannot impose negative transfers when no cost padding is found. Auditor limited liability (or, similarly, risk aversion) ensures that the regulator cannot perfectly recoup expected rewards through an ex ante contract.

The _classical_ _regime_ thus prevails for a smaller set of parameters than in the absence of collusion. For, it requires the constraint

(3.19) $\Phi(\bar{e}_0) \geq y\bar{t}_0 + (1-y)\bar{t}_\alpha + \alpha' - \psi(\bar{e}_0 - \Delta\beta + \alpha)$,

to be non-binding. But if this constraint is non binding, $\bar{t}_\alpha - \bar{t}_0$ (in order to reduce s_α), and therefore a necessary and sufficient condition for the classical regime to prevail is:

(3.20) $\Phi(\bar{e}_0) \geq \psi(\bar{e}_0) - \psi(\bar{e}_0 - \Delta\beta + \alpha) + \alpha'$

or

(3.21) $\psi(\bar{e}_0 - \Delta\beta + \alpha) - \psi(\bar{e}_0 - \Delta\beta) \geq \alpha'$.

The classical regime thus prevails if α' is much smaller than α.

Last, we turn to the _repressed_ _cost-padding_ _regime_. The constraints are still (3.10) and (3.11), together with

(3.22) $s_\alpha \geq \dfrac{\psi(\bar{e}_1) - \bar{t}_\alpha}{x(1+\lambda_f)}$,

where use is made of the individual rationality constraint (3.9). Letting κ and ς denote the shadow prices of (3.10) and (3.11) for the new program, the principal maximizes

(3.23) $\tilde{W} = W - \lambda(1-x)\dfrac{\psi(\bar{e}_1) - \bar{t}_\alpha}{x(1+\lambda_f)}$,

where W is given in (3.14), with respect to $\bar{e}_1$ and

$$\bar{t}_\alpha \in \left[0, \left[\psi(\bar{e}_1 + \alpha) - \frac{y}{x}\psi(\bar{e}_1) - \alpha'\right] \Big/ \left[(1-y) - \frac{y(1-x)}{x}\right]\right],$$

where the upper bound in this interval reflects the constraint that type $\bar{\beta}$ does not engage in cost padding. For a given $\bar{e}_1$, $\tilde{W}$ is linear in $\bar{t}_\alpha$. The solution is, therefore, a corner solution. The coefficient of $\bar{t}_\alpha$ is

$$\frac{\lambda(1-x)}{x(1+\lambda_f)} - \varsigma\left[(1-y) - y\left(\frac{1-x}{x}\right)\right],$$

which may be positive or negative depending on the values of the parameters

(recall that $\varsigma = \lambda\nu\cdot\kappa$). In particular, optimal penalties may be limited (but

not equal to zero, unlike in the full-cost-padding regime).

If the optimum specifies $\bar{t}_\alpha = 0$ (maximal penalty), then the maximization

of $\bar{W}$ with respect to $\bar{e}_1$ shows that $\bar{e}_1$ is smaller than in the absence of

collusion (as can be shown by a simple revealed preference argument). The

same property holds when $\bar{t}_\alpha$ is equal to the upper bound of the interval

(again, by a revealed preference argument). Last, we note that the welfare in

the repressed-cost-padding regime increases with λ_f; while that in the

cost-padding region is independent of λ_f. Therefore, the set of parameters

such that the repressed-cost-padding regime is optimal shrinks.

We have seen that $\bar{e}_1$ is lowered by collusion in the repressed-cost-

padding regime and is unaffected in the other two regimes. What remains to be

analyzed is the effect on $\bar{e}_1$ of a regime switch induced by collusion. If the

regime switches from classical to repressed-cost-padding, $\bar{e}_1$ increases, while

it increases when the regime switches from repressed-cost-padding to

cost-padding.

We gather our main results in the next Proposition:

<u>Proposition 4</u>: When collusion becomes easier ($\lambda_f \downarrow$)

        a)   the classical region shrinks,

        b)   the cost padding region expands,

        c)   limited but non-zero penalties may be optimal,

        d)   the power of incentive schemes decreases in the repressed

            padding regime, and remains unchanged within the classical and

            cost padding regimes,

        e)   the power of incentive schemes decreases if the regime

            switches from repressed-cost-padding to cost-padding, but

            increases when the regime switches from classical to

            repressed-cost-padding.

Figure 1 describes how the inefficient type's level of effort is affected by cost padding in the repressed cost padding regime.
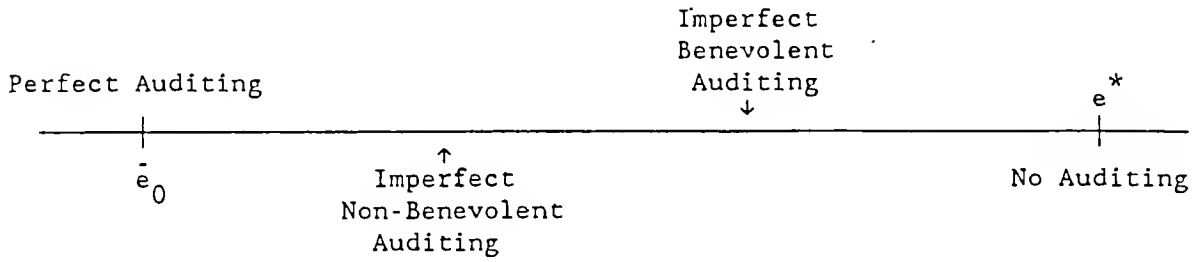

<u>Figure 1</u>

Figure 2 summarizes Proposition 4 taking the probability y, as variable (similar figures could be drawn for other parameters, e.g. α').
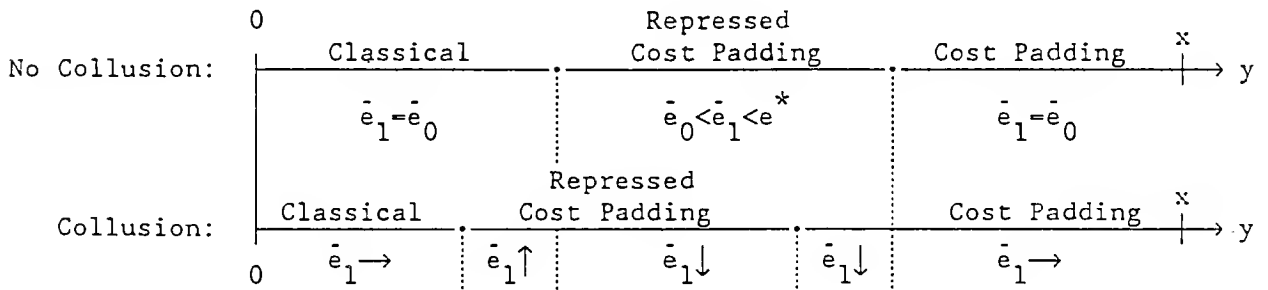

<u>Figure 2</u>

When the probability of catching cost padding is very low (y high) cost padding occurs for type $\bar{\beta}$: this is the cost padding regime. The effort level of type $\bar{\beta}$ is the same as without cost padding. The marginal disutility of effort for type $\underline{\beta}$ is equal to 1, and therefore type $\underline{\beta}$ has no incentive for cost padding.

When the probability of catching cost padding increases, type $\bar{\beta}$ no longer engages in cost padding. This first gives rise to the repressed cost padding regime, in which type $\underline{\beta}$ might want to do some cost padding if it were mimicking type $\bar{\beta}$. To make this mimicking more costly, the effort level of type $\bar{\beta}$ is decreased, decreasing the rent that type $\underline{\beta}$ would obtain from

mimicking type $\bar{\beta}$. In equilibrium, type $\underline{\beta}$ exerts the efficient level of effort and does no cost padding.

When the probability of catching cost padding becomes even higher, we switch to the classical regime in which type $\underline{\beta}$ would not cost pad if it were to mimic type $\bar{\beta}$. The effort level of type $\bar{\beta}$ and the rent of type $\underline{\beta}$ return to the levels that obtain when cost padding is impossible.

4.   Monitoring of effort.

Last, we study the regulator's monitoring of the firm's effort. For clarity, we assume away cost padding ($e_2 = 0$). Accordingly, we will drop the subscript "1" under the effort variable, as there is no risk of confusion.

4.1 *Benevolent monitoring of effort.*

With probability p, the regulator perfectly observes the effort exerted by the firm, and with probability (1-p), he obtains no new information. When an inappropriate level of effort is discovered, the regulator can impose a penalty as large as the net transfer; however, he cannot impose larger penalties because the firm is protected by limited liability.[13]

Let $(\underline{t},\underline{C})$, $(\bar{t},\bar{C})$ denote a pair of contracts for types $\underline{\beta}$ and $\bar{\beta}$. The generalization of the incentive compatibility condition (2.6) is

(4.1) $\underline{t} - \psi(\underline{\beta} - \underline{C}) \geq (1-p)(\bar{t} - \psi(\underline{\beta} - \bar{C})) - p\psi(\underline{\beta} - \bar{C}).$

This formulation presumes the obvious facts that (in the absence of collusion) the efficient type faces the maximal penalty when he is caught

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[13] See Bolton [1986], Guasch and Weiss [1982], Mirrlees [1974], Nalebuff and Scharfstein [1987], and Polinsky and Shavell [1979] for the general theory of testing with adverse selection when there is no limited liability constraint. In contrast, some of the literature on crime deterrence (see Malik [1990] for a recent contribution) assumes risk neutrality and limited liability.

lying about his effort level and that the inefficient type's incentive compatibility constraint is not binding.

The individual rationality constraints are:

(4.2) $\underline{t} - \psi(\underline{\beta} - \underline{C}) \geq 0$.

(4.3) $\bar{t} - \psi(\bar{\beta} - \bar{C}) \geq 0$.

The regulator maximizes expected social welfare

(4.4) $W = \nu[S - (1+\lambda)(\underline{C} + \psi(\underline{\beta} - \underline{C})) - \lambda[(1-p)\psi(\bar{\beta} - \bar{C}) - \psi(\underline{\beta} - \bar{C})]]$

$+ (1-\nu)[S - (1+\lambda)(\bar{C} + \psi(\bar{\beta} - \bar{C}))]$,

which is obtained from (4.1) and (4.3). We ignore (4.2) (if p is sufficiently large, the right-hand side of (4.2) is negative, and (4.2) must be reintroduced). That is, we assume that monitoring of effort does not solve the rent extraction problem perfectly.

An interior maximum must satisfy[14]

(4.5) $\psi'(\underline{e}) = \psi'(\underline{\beta} - \underline{C}) = 1 \iff \underline{e} = e^*$

(4.6) $\psi'(\bar{e}) = \psi'(\bar{\beta} - \bar{C}) = 1 - \dfrac{\lambda}{1+\lambda} \dfrac{\nu}{1-\nu} [\Phi'(\bar{e}) - p\psi'(\bar{e})] \Rightarrow \bar{e} > \bar{e}_0$.

As p increases, $\bar{e}$ increases from $\bar{e}_0$ and reaches e^* for

(4.7) $p^* = 1 - \dfrac{\psi'(e^* - \Delta\beta)}{\psi'(e^*)}$.

Monitoring of effort enables the regulator to reduce the informational rent and consequently leads to a smaller distortion of effort for the inefficient type. If $\Lambda(p)$ is the (increasing and convex) monetary cost of a monitoring scheme with parameter p, the optimal p is defined by

(4.8) $(1+\lambda)\Lambda'(p) = \lambda\nu\psi(\bar{e})$,

---

[14] We assume that p does not interfere with the concavity of social welfare in $\bar{e}$ (which is the case, for instance, if $\nu \leq 1/2$).

from the envelope theorem.

Remark: A difference between this section and the literature on auditing of private information parameters or of effort (Baron-Besanko [1984], Kofman-Lawarrée [1989]) is that the maximal penalty is endogenous. While this literature assumes a transfer-independent penalty, we interpret limited liability as the regulator's inability to extract money from the agent, implying that the maximal penalty is the retention of the transfer. The results are accordingly different. Baron-Besanko and Kofman-Lawarrée prove a "separation property": When the quality of monitoring improves (p increases in our model), the principal first extracts more and more informational rents and does not change the allocation (effort, output). Only when informational rents are extracted is the allocation affected. In contrast, our assumption that the penalty is the absence of reward implies that both the allocation (here, effort) and the informational rent are affected simultaneously.[15]

4.2 Collusion in monitoring of effort.

So far, we have assumed that the monitoring of effort was costly but benevolent. Suppose now that the monitoring is realized by a supervisor who can claim that he did not observe the effort level even if he did. As in Section 3.2, we assume that the supervisor's utility function is $V(s) = s$, $s \geq 0$, where s is his income. When he observes the effort level, this is hard information and he cannot lie about its level. The supervisor may now be captured by the firm. Let $(1+\lambda_f)$ be the marginal cost of internal side payments in the coalition formed by the supervisor and the firm. Suppose that

---

[15] At the end of their paper, Kofman and Lawarrée break the separation result in another way by assuming that the principal cannot commit not to renegotiate.

the supervisor is given income:

(4.9) $s \geq \dfrac{\bar{t}}{1+\lambda_f} - \dfrac{\psi(\bar{e})}{1+\lambda_f}$,

when revealing that the firm lied about its effort and 0 otherwise. Suppose further that the incentive scheme for the firm is unchanged. In particular, the firm receives no transfer when caught lying. Then, collusion does not occur; and because the efficient firm does not lie in equilibrium, the income s is never paid, and collusion can be fended off costlessly.

However, suppose that the supervisor can ex ante offer the efficient type to produce at cost $\bar{C}$, that is to exert a low effort level. Let $1+\lambda_a$ be the marginal cost of transfers from the supervisor to the firm. Suppose that the firm has all the bargaining power. To prevent this type of collusion, the firm's rent must now be:[16]

(4.10) $\underline{U} = \Phi(\bar{e}) - p\psi(\bar{e}) + p\,\dfrac{\psi(\bar{e})}{(1+\lambda_f)(1+\lambda_a)}$.

This creates an additional social loss of

$$\nu\lambda p\,\dfrac{\psi(\bar{e})}{(1+\lambda_f)(1+\lambda_a)},$$

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[16] We assume here that (for $\beta = \underline{\beta}$) this type of collusion occurs only when the supervisor discovers the effort level, i.e., with probability p, hence the additional rent $p\,\dfrac{\psi(\bar{e})}{(1+\lambda_f)(1+\lambda_a)}$. However, if the firm were to provide verifiable information about the effort level to the supervisor, collusion could happen with probability one. If $p > \dfrac{1}{(1+\lambda_f)(1+\lambda_a)}$, the result would be similar except that the inefficient type's effort would be even lower. If $p < \dfrac{1}{(1+\lambda_f)(1+\lambda_a)}$, i.e., the monitoring technology is inefficient, the supervisor would be dismissed.

leading to an optimal effort level defined by:

(4.11) $\psi'(\bar{e}) = 1 - \dfrac{\lambda}{1+\lambda} \dfrac{\nu}{1-\nu} \left[\Phi'(\bar{e}) - p\psi'(\bar{e}) \left[1 - \dfrac{1}{(1+\lambda_f)(1+\lambda_a)} \right] \right].$

The threat of collusion reduces the value of monitoring for the principal and induces a move towards the optimal contract without monitoring.

The optimal level of monitoring is now defined by

(4.12) $(1+\lambda)\Lambda'(p) = \lambda\nu\psi(\bar{e}) \left(1 - \dfrac{1}{(1+\lambda_f)(1+\lambda_a)} \right).$

Straightforward revealed preference arguments lead to:

Proposition 5:   For an interior optimum:

(1) When the costs of side transfers (λ_a or λ_f) increase, monitoring expenditures (p) increase, and incentives schemes become more powerful.

(2) When the marginal cost of monitoring increases incentive schemes become less powerful and monitoring expenditures decrease.

(3) When uncertainty increases ($\Delta\beta \uparrow$), incentive schemes become less powerful and there is less monitoring.

The intuition for these results is as follows. The cross partial derivative of the social welfare function with respect to p and $\bar{e}$ (which is equal to $\nu\lambda \left(1 - \dfrac{1}{(1+\lambda_f)(1+\lambda_a)} \right) \psi'(\bar{e})$) is positive. Thus, *ceteris paribus*, an increase in monitoring raises the desirability of powerful incentives, and powerful incentives raise the benefit of monitoring. Another way of looking at this is to note that monitoring and low incentives are substitute instruments to extract the firm's rent. An increase in the use of one instrument makes the other instrument less attractive.

The analysis is summarized in Figure 3 which describes the inefficient type's effort level:
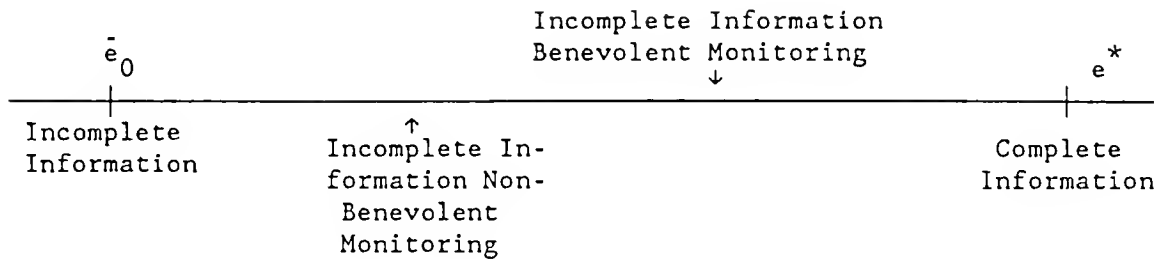
$$\bar{e}_0 \qquad\qquad \text{Incomplete Information} \qquad\qquad e^*$$

	Incomplete Information Benevolent Monitoring $\downarrow$	
Incomplete Information	$\uparrow$ Incomplete Information Non-Benevolent Monitoring	Complete Information

Figure 3

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Appendix 1:   Proof of Proposition 3

Four types of optima are possible: Type 1:   there is no cost padding. Type 2:   there is cost padding by the inefficient firm only.   Type 3:   there is cost padding by the efficient firm only.   Type 4:   there is cost padding by both types of firm.

Lemma 1:   For each type of optimum, the efficient type faces a fixed price contract and therefore does not engage in cost padding.

Proof: For each type of optimum, the proof is similar to the one in Section 2.   The key observation is that the regulator's welfare is affected by incomplete information only through the rent of the efficient type.   This rent depends only on the effort level of the inefficient type.   So the maximization with respect to the efficient type's effort level is as under complete information.

■

From Lemma 1, we can restrict attention to types of equilibria 1 and 2.

Lemma 2:   Penalties can always be chosen to be maximal.

Proof: The two binding constraints are the inefficient type's IR constraint and the efficient type's IC constraint.   Moreover transfers are costly.

The IR constraint can be satisfied at the same expected cost with $\bar{t}_\alpha = 0$ by adjusting appropriately $\bar{t}_0$.

In a type 2 optimum, where the bad type engages in cost padding, we know from Proposition 1 that the efficient type wishes to cost pad too when mimicking the inefficient type.   Choosing $\bar{t}_\alpha = 0$ thus does not affect the incentive constraint.   The situation is similar in the type 1 optimum when the efficient type does not wish to cost pad when mimicking the inefficient type.

In the type 1 optimum, when the efficient type wishes to cost pad when mimicking the inefficient type, choosing $\bar{t}_\alpha = 0$ weakens the IC constraint because of the MLRP property: the IC constraint is then

$$\underline{U} \geq y\bar{t}_0 + (1-y)\bar{t}_\alpha - \psi(\bar{e}_1 - \Delta\beta + \alpha) + \alpha'$$

$$- \frac{y}{x}\psi(\bar{e}_1) - \psi(\bar{e}_1 - \Delta\beta + \alpha) + \left[(1-y) - y\frac{(1-x)}{x}\right]\bar{t}_\alpha + \alpha',$$

by using the inefficient type's IR constraint.

From the MLRP property, $1 - y - y\frac{(1-x)}{x} < 0$. ∎

Consider type 2 equilibria first. From Proposition 1, we know that the efficient type will cost pad when mimicking the inefficient type. The IC constraint, which defines the efficient type's rent, is therefore:

(A.1) $\qquad \underline{U} = y\bar{t}_0 + (1-y)\bar{t}_\alpha + \alpha' - \psi(\bar{e}_1 - \Delta\beta)$.

The other binding constraint is the inefficient's type IR constraint:

(A.2) $\qquad y\bar{t}_0 + (1-y)\bar{t}_\alpha + \alpha' = \psi(\bar{e}_1)$.

Using (A2) the efficient type's rent can be written:

$$\underline{U} = \psi(\bar{e}_1) - \psi(\bar{e}_1 - \Delta\beta).$$

The regulator's program is then:

$$\underset{\{\bar{e}_1, \underline{e}_1\}}{\text{Max}} \left\{ \nu[S - (1+\lambda)(\underline{\beta} - \underline{e}_1 + \psi(\underline{e}_1)) - \lambda(\psi(\bar{e}_1) - \psi(\bar{e}_1 - \Delta\beta))] \right.$$

$$+ (1-\nu)[S - (1+\lambda)(\bar{\beta} - \bar{e}_1 + \psi(\bar{e}_1))]$$

$$\left. - (1-\nu)(1+\lambda)(\alpha - \alpha') \right\},$$

where $\alpha - \alpha'$ is the effective cost increase due to (inefficient) cost padding. Type $\bar{\beta}$ increases cost by α but benefits only by α' (which is therefore the maximal amount by which its transfer can be decreased while still respecting

its IR constraint).

This program differs from the no-cost padding model only through the constant $-(1-\nu)(1+\lambda)(\alpha-\alpha')$ and therefore leads to $\underline{e}_{-1} = e^*$ and $\bar{e}_1 = \bar{e}_0$.

This case occurs when firm $\bar{\beta}$ wishes to cost pad, i.e.:

$$0 \geq \frac{x}{y}(\psi(\bar{e}_0)-\alpha')-\psi(\bar{e}_0-\alpha).$$

Therefore, it occurs for y close to x and α' close to α, i.e., when cost padding is difficult to detect or not socially costly. We refer to this case as the cost padding regime.

Consider now type 1 equilibria. The inefficient type does not engage in cost padding. We must distinguish between two subcases. The rent of the efficient type must be such that it does not wish to mimick the inefficient type either without cost padding

(A.3) $\underline{U} \geq \Phi(\bar{e}_1)$,

or with cost padding

(A.4) $\underline{U} \geq y\bar{t}_0+(1-y)\bar{t}_\alpha+\alpha'-\psi(\bar{e}_1-\Delta\beta+\alpha)$.

Moreover, the inefficient type's IR constraint must be binding:

(A.5) $\bar{U} = x\bar{t}_0+(1-x)\bar{t}_\alpha-\psi(\bar{e}_1) = 0$.

If (A.4) is not binding, then $\bar{U} = \Phi(\bar{e}_1)$ as in the case where cost padding is not feasible. The optimal regulation is as in Section 2. We call this regime the <u>classical</u> <u>regime</u> and it obtains if type $\underline{\beta}$ does not want to cost pad when mimicking the inefficient type, i.e.:

$$\Phi(\bar{e}_0) \geq \frac{y}{x}\psi(\bar{e}_0)-\psi(\bar{e}_0-\Delta\beta+\alpha)+\alpha'$$

where use is made of (A.5).

If (A.4) is binding, we get the repressed cost padding regime (see the text).

Date Due